

short at the northern limits of New South Wales, and makes the coal-field of that colony Mesozoic, against the earnest protest of the Rev. W. B. Clarke, whose judgment on all matters concerning the geology of New South Wales is not to be lightly opposed. Cretaceous strata, first recognised from fossil evidence by Prof. M'Coy, are represented as covering a wide belt of country from the plains south of the Darling northwards to the Gulf of Carpentaria. The tertiary deposits are massed under one tint, which spreads over most of the interior, sweeping up to the base of the inland slopes of the Eastern Alps, and down to the coast-line for many leagues on the northern, western, and southern margins of the country.

No arrows to show prevalent inclinations of strata have been inserted on the map, and as no illustrative sections are given, the reader is left to infer the relations of the formations whose general area and boundaries are so clearly defined. The required information may be expected in the promised text to accompany the map. Another omission is the want of any sign for the gold and coal-fields. This might have been easily inserted without any diminution of the clearness and beauty of the map, and would have been of value to those who take interest in the mineral resources of the country. It is to be hoped that a new edition will soon be demanded, and that these small defects in a most useful and meritorious work will be supplied.

PHYSICAL SCIENCE IN SCHOOLS

WE have received the following additional letters on this subject:—

Your Rugby correspondents appear to me somewhat to misapprehend Dr. N. M. Watts's arguments on this important question. No satisfactory results, he maintains, can accrue from science teaching in schools until the subject is placed upon its true position of *educational equality*, both as regards range and time, with classics and mathematics, and no system of regulations or of examinations can be said to fulfil its object in which this position is ignored. I for my own part most cordially support Dr. Watts's views. The position at present accorded to science in English schools is, as Sir John Lubbock has clearly shown, anything but satisfactory, and this state of things seems likely to continue so long as the examinations for which the boys prepare persist in placing the science subjects in a distinctly inferior position to the older studies. Surely it is the part of examining bodies to lead and raise the education of the country. I think, however, that it has been fully proved that the "Oxford and Cambridge Schools Examination Board" has not done this, at any rate so far as science is concerned. The facts adduced by Mr. Cumming as to the small number of candidates presenting themselves for examination in science proves to my mind that the teaching of science is usually discouraged because it is usually not understood, and no efficient means of teaching science being as a rule provided, these subjects are not only neglected but their study becomes even despised by the boys. The truth is that it is the difficulty of obtaining such men as Mr. Wilson and Dr. Watts which renders the progress of science teaching in schools less rapid than some of us could wish. As soon as the supply of really competent and high class natural science masters becomes as large as that of equally distinguished teachers of classics or mathematics we may be sure that science will occupy no inferior position. Until that time arrives it behoves all those interested in the educational applications of science to take care that the teaching is really exact, methodical, and disciplinary, in short, scientific, so that if we do not progress rapidly we advance all the more surely, and we look with interest to the results of the education in those few schools such as Giggleswick and

Newcastle-under-Lyne, in which science has already been placed on a footing of equality with the older studies.

Manchester, Feb. 26

HENRY E. ROSCOE

The remarks of Dr. Marshall Watts on physical science in schools in NATURE (vol. xiii., p. 311), seem to me to call for one or two observations in addition to those made by Mr. Wilson and Mr. Cumming in your columns last week (p. 329).

Dr. Watts selects a few questions from the examination papers that were set in heat, chemistry, and geology, by the Oxford and Cambridge Schools Examination Board in 1854, the first year of its existence, in order to show what he considers the very elementary nature of the knowledge required, and he adds that "with the exception of the last question [naming certain rocks and fossils] there is no test of a practical kind at all."

Now it is only fair to state that although it is quite true that there was no examination in practical chemistry in 1854, yet in the regulations for the next year "the elements of practical qualitative analysis" were added to "the elementary parts of inorganic chemistry," and last July those candidates who took in chemistry were examined for three hours in practical laboratory work, six substances being given to each boy for analysis.

Moreover, with regard to theoretical chemistry, the paper that was set last year was decidedly harder than that of the year before. I inclose a copy, and should be glad if you could find space to print it. As a matter of fact it is harder than the average chemistry papers of the London University Matriculation Examination, and quite as hard as an ordinary Oxford Pass Paper.

"Natural Philosophy (Chemical Division.) (Time 1½ hours.)

A.

"1. What happens when pure iron is dissolved in excess of dilute sulphuric acid? Give an account of the properties of the solution which is obtained, and the tests by which you would show what salt of iron is present. Suppose some of the solution were boiled with potassium nitrate, what changes would you expect to take place?"

"2. Explain atom, molecule, acid, base. How can you show the composition by weight and volume of hydrogen with chlorine, bromine, and iodine? mention the best methods of obtaining these compounds in the state both of gas and in solution.

"3. How is analysis of air made with the eudiometer? Describe how to correct the observations for pressure, temperature, and aqueous vapour. Suppose 100 c.c. of oxygen to be mixed with 10 c.c. of marsh gas and exploded, find the amount of the residual gases.

"4. What is the percentage composition of nitrous and nitric oxides? How are these bodies prepared? Distinguish between the properties of nitrates and nitrites.

"5. Describe briefly the manufacture either of sulphuric acid or of bleaching powder.

"6. Account for the production of carbon monoxide in the blast furnace, and show what action it has in reducing the roasted iron-stone. What is the best method of preparing carbon monoxide: in what respects does it differ from the di-oxide?"

"7. How is the metal aluminium prepared? Describe the manufacture of alum, and give a brief account of the properties of alumina.

"8. Describe the preparation and properties of the bodies SnCl_4 , HgC_2N_2 , PbO_2 , $\text{K}_2\text{Cr}_2\text{O}_7$, HCN .

"Practical Chemistry. (Time 3 hours.)

"1. The substances marked 1, 2, 3, 4 are simple salts.

"2. The substances marked 5, 6 are elements.

"You are requested to find out what they are, and to write a full account of the methods you use."

Now at the risk of being accused of taking a low standard, I cannot help thinking that although some of these

questions may be called "very easy," yet there are others quite sufficiently difficult for the ordinary public school-boy, who has a great many other things to work at besides natural science.

A boy must have read his chemistry thoughtfully, to say the least, who could answer the whole of Question 1 thoroughly. In Question 2 there is ample opportunity for showing a deeper knowledge than could be obtained by skimming over some "outlines of chemistry." So again the explanation and illustration of the peculiar oxidising and reducing properties of *nitrites*, in Question 4, and the description of the preparation and properties of the different bodies enumerated in Question 3, could, I maintain, only be given satisfactorily by boys who had acquired something more than a mere "modicum" of chemical knowledge.

It must also be borne in mind that in order to pass the Chemical Division of Group IV., a boy must take in, in addition to the chemistry of the metallic and non-metallic elements and practical analysis, either heat or magnetism and electricity.

Now although there may be reasons for combining together heat and chemistry, so long as it is understood that only the more elementary parts of heat will be required, yet it is certainly unreasonable to add on as an extra such a very comprehensive subject as that of magnetism and electricity, frictional and voltaic, including electro-magnetism.

Surely, to say the least, electrical science is quite as worthy of an independent existence as botany or geology, and I much doubt whether many would hesitate in admitting it to be much harder than either.

My own opinion is in favour of Mr. Wilson's suggestion—to divide Group IV. into Pass subjects and Honour subjects, requiring only an elementary knowledge of theoretical chemistry, and perhaps the simpler parts of heat for the one, while practical analysis with higher knowledge of heat, or electricity and magnetism, might be required from those who aimed at taking honours in science.

It is perhaps due to the school to say that we can hardly be supposed to be frightened at the prospect of these examinations. Last July three in the Sixth took in chemistry as a certificate subject: all passed and two obtained "distinction"—three being the total number who obtained such distinction out of the twenty-eight candidates who presented themselves for examination in this subject.

T. N. HUTCHINSON

Rugby

In my letter last week, p. 329, I said that the papers set in science in the certificate examination *last year* were very easy. This was a slip. I was absent from England when they were set, and had never seen them. I had in my mind the papers of the year before.

The papers of last year were quite hard enough. It must be remembered that very many schools give only *two lessons a week* to science.

JAMES M. WILSON

ANNIVERSARY ADDRESS OF THE PRESIDENT OF THE ROYAL GEOLOGICAL SOCIETY, JOHN EVANS, F.R.S.

MR. EVANS began by referring to the immense advances in geological science since 1825, when the Society received its charter, and pointed out that although there now existed a considerable body of professional or trained geologists, yet amateurs need not be discouraged from taking up the science which now embraces so wide a field that there is ample room for both. He then referred to the prosperity of the Society, to its publication, its medals, and other means for fostering the science, and to its valuable museum, an "interesting notice of which," he intimated, "appeared in NATURE, vol. xiii. p. 227." Mr. Evans then spoke of the present prospects of the science, of the bearing which recent discoveries in other branches of

knowledge has upon it, and of the direction in which future discoveries are likely to be made. In this connection he referred to the recent researches in solar physics by means of spectrum analysis and solar photography, as having a close and intimate bearing on the early history of the earth, and which was discussed by Prof. Prestwich in his inaugural lecture at Oxford (NATURE, vol. xi. p. 290). He spoke also of the importance of spectrum analysis to the metallurgist, referring to the researches of Mr. W. C. Roberts in quantitative analyses of gold-copper alloys. Mr. Evans then spoke at some length of the important results already attained by the *Challenger Expedition* as to the nature of the sea-bottom. In speaking of the Arctic Expedition, from which geology hopes to gain much, he referred to the powerful evidence which exists in the fossil flora of Greenland and Spitzbergen, of the prevalence in the Arctic regions at one period of a distinctly warm climate.

Mr. Evans then went on to say:—The three points which it appears to me are most important to bear in mind with regard to the Arctic flora are:—1, That for vegetation such as has been described, there must, according to all analogy, have been a greater aggregate amount of summer heat supplied than is now due to such high latitudes; 2, that there must have been a far less degree of winter cold than is in any way compatible with the position on the globe; and 3, that in all probability the amount and distribution of light which at present prevail within the Arctic circle are not such as would suffice for the life of the trees.

Should the present Arctic expedition succeed in finding traces of what must be regarded as a temperate, if not indeed a sub-tropical fossil flora, like that of Greenland, and Spitzbergen, extending to latitudes still nearer the pole, it does appear to me that geologists will be compelled to accept as a fact that the position of the axis of rotation of our planet has not been permanent; and they will have to call upon astronomers to find some means of admitting what they now regard as impossible.

An astronomer and mathematician of no mean ability, the late Sir John W. Lubbock, in a paper communicated to this Society in 1848, has speculated upon this subject, which was in consequence discussed by the late Sir Henry Delabèche in his Presidential Address in 1849.

Sir John Lubbock remarked that the dictum of Laplace as to the impossibility of accounting for the changes which have taken place on the surface of the earth, and in the relative positions of land and water, by a change in the position of the axis of rotation, was founded upon the absence of two considerations, both of which appeared to him essential. These were—

1. The dislocation of strata by cooling,
2. The friction of the surface.

The latter consideration is apparently of but little importance; but with regard to the former, he pointed out how, if from any cause the axis of rotation did not coincide with the axis of figure, the pole of the axis of rotation would describe a spiral round the pole of the axis of figure until it finally became, as it is at present, identical with it. He considered it unlikely that originally the axis of rotation should have coincided exactly with the axis of figure, unless the whole globe were perfectly fluid; but added that we might go back to a time less remote, when the earth was in a semifluid state, and in consequence of the different degrees of fusibility of different substances, was partly solid, in irregular masses, and the two axes did not, in consequence, coincide. We might, he added, assume the original state of want of uniformity between them to have been at a period even more recent, when the earth consisted of land and water, and was suited for the support of animal life. He then proceeds to show how, if, after any length of time the solid spheroidal part of the earth moved about any new axis of rotation, the water would occupy a new position about a new equator, land would become sea, and sea land, &c.

He adds that if the axis of the earth would suffer a displacement by reason of the causes which produce the precession of the equinoxes, we should have another and more natural way of accounting for the existing phenomena; but this has been held to be impossible.

I am not at present going to question whether this holding is correct; but with regard to Sir J. W. Lubbock's reasoning as to the necessity of the axis of figure coinciding with that of rotation, it appears to me of the greatest importance; for if it hold good, any alteration in figure cannot but have some effect on the position of the axis of rotation. No doubt, if the whole globe, or even the solid portion of it, were a regular spheroid, with a large